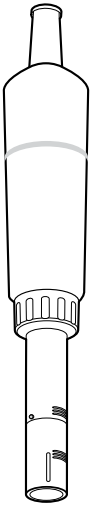
User Guide

RDO® Optical Dissolved Oxygen Sensor



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This publication supersedes all previous publications on this subject.

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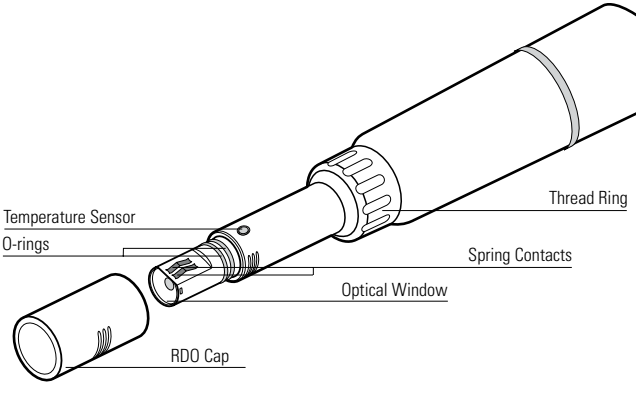
Introduction

This user guide contains information on the preparation, operation and maintenance of the Thermo Scientific Orion RDO optical dissolved oxygen sensors. These dissolved oxygen sensors are compatible with a wide range of applications including rugged field applications, water and wastewater analysis, beer and wine testing and BOD (biochemical oxygen demand) analysis. All of the RDO sensors feature automatic temperature compensation and convenient press-on RDO caps.

Orion Star™ RDO Optical Dissolved Oxygen Sensors

The Orion Star RDO optical dissolved oxygen sensors have a 9 pin miniDIN connector that ensures a waterproof and secure connection when used with the Orion Star Plus RDO optical dissolved oxygen meters.

Figure 1 – RDO Optical Dissolved Oxygen Sensor



Required Equipment

1. Thermo Scientific Orion Star Plus RDO optical dissolved oxygen meter.

2. Thermo Scientific Orion RDO optical dissolved oxygen sensor.

3. RDO cap, Cat. No. 087001.

4. Calibration sleeve, Cat. No. 087003.

5. Stainless steel protective sensor guard (optional), Cat. No. 087002.

6. Magnetic stirrer or stirrer probe, Cat. No. 096019. The stirrer probe can be used with 3-Star, 4-Star and 5-Star Plus benchtop RDO meters.

7. Distilled or deionized water.

Important Notes – Read Before Assembling or Operating the Equipment

Note: *Do not touch the bottom of the RDO cap, optical window or spring contacts on the RDO sensor.*

Note: *The RDO sensor has an internal clock that counts down the 365 day lifespan of a new RDO cap. The countdown begins when the RDO cap is installed on the RDO sensor, the sensor is connected to the meter and the first measurement is taken. The 365 day countdown cannot be reset or changed once the first measurement is taken.*

RDO Sensor Preparation

1. Remove the protective shipping cap from the end of the RDO sensor

2. Lubricate the two O-rings on the RDO sensor with a thin film of the silicone grease that is supplied with the sensor.

3. Align the arrow on the RDO cap with the arrow on the RDO sensor. See **Figure 2**.

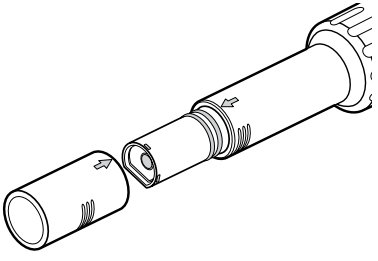


Figure 2

4. Slide and press the RDO cap onto the RDO sensor until the cap is flush with the sensor body. See **Figure 3**.

Note: *Do not twist the RDO cap. Once the cap is installed, the cap should not be removed from the RDO sensor until a new cap needs to be installed or troubleshooting needs to be performed.*

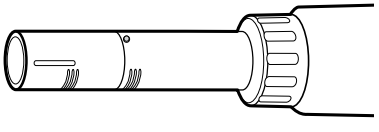


Figure 3

5. Connect the RDO sensor to the 9 pin miniDIN input on the meter. See **Figure 4**.

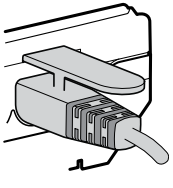


Figure 4

Note: *An Err 880 message on the meter indicates that the RDO sensor is not fully connected to the meter. If this error appears, reconnect the sensor by firmly pushing the connector into the 9 pin miniDIN meter input.*

Note: *An Err 882 message on the meter indicates that the RDO cap is missing or not properly installed on the sensor.*

RDO Sensor Calibration

Calibration of an RDO optical dissolved oxygen sensor can be done quickly and conveniently by performing a water-saturated air calibration. Under equilibrium conditions, the partial pressure of oxygen in air-saturated water is equal to the partial pressure of oxygen in water-saturated air. This means that a sensor calibrated in water-saturated air will correctly read the partial pressure of oxygen in water samples. When measuring low concentration samples (less than 1 ppm), a second calibration with a zero oxygen standard is recommended.

Calibration Sleeve Preparation for Water-Saturated Air Calibration

1. Remove the cap from the calibration sleeve and remove the sponge from the cap.

2. Saturate the sponge with distilled water and squeeze the excess water out of the sponge.

3. Reassemble the calibration sleeve.

4. Unscrew and remove the thread ring from the RDO sensor. See **Figure 5**. Slide the calibration sleeve over the front of the RDO sensor and screw the sleeve onto the sensor.

5. Wait at least five minutes for the RDO sensor to equilibrate.

6. Follow the instructions in the meter user guide for performing a water-saturated air calibration.

Zero Oxygen Solution for Zero Point Calibration

1. Perform a water-saturated air calibration.

2. Prepare a sodium sulfite solution by dissolving about 15.0 g of Na_2SO_3 in about 250 mL of distilled water. Transfer the solution to a BOD bottle or flask.

   Note: *A small amount of cobalt salt can be added to the sodium sulfite solution. The cobalt salt will act as an indicator and change color when the sodium sulfite solution no longer has a zero oxygen content.*

3. Add a stir bar to the bottle or flask. Insert the RDO sensor into the bottle or flask and use parafilm to seal the open area between the bottle or flask and the sensor.

4. Place the bottle or flask on a magnetic stir plate and gently stir the solution.

5. Wait at least five minutes for the RDO sensor to equilibrate.

6. Follow the instructions in the meter user guide for performing a zero point calibration.

7. Thoroughly rinse the RDO sensor under running water and blot it dry with a lint-free tissue.

Note: *If the RDO sensor is sluggish or inaccurate after a zero point calibration, not all of the sodium sulfite was removed from the sensor. A very thorough soaking and rinsing of the RDO sensor in distilled water is required to remove all of the sodium sulfite solution and restore the sensor performance. Soak the RDO sensor in distilled water for 30 minutes, blot it dry with a lint-free tissue, use a wash bottle to rinse the sensor with distilled water, soak the sensor for another 30 minutes in fresh distilled water and blot it dry with a lint-free tissue.*

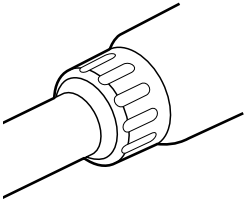
Stainless Steel Protective Guard

The RDO optical dissolved oxygen sensor can be used with the stainless steel protective guard, Cat. No. 087002. The guard protects the RDO sensor from damage and adds weight to the sensor for low depth measuring applications.

Installation of the Protective Guard

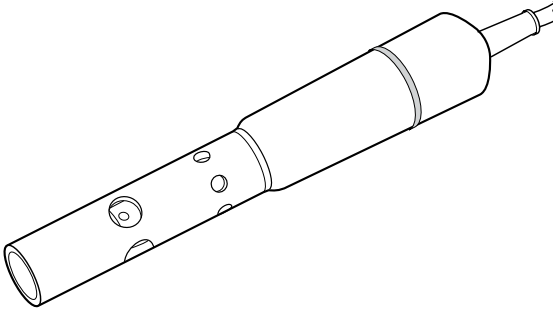
1. Unscrew and remove the thread ring from the RDO sensor. See **Figure 5**.

Figure 5 – Thread Ring



2. Slide the protective guard over the front of the RDO sensor and screw the guard onto the sensor. See **Figure 6**.

Figure 6 – RDO Sensor with Protective Guard



RDO Sensor Measurements

For accurate measurements, the RDO sensor must be immersed in solution until the temperature sensor is covered by at least a ½ inch of the solution.

If any salt or mineral deposits are observed on the RDO sensor, immediately rinse them off with distilled or deionized water.

1. Rinse the RDO sensor with distilled water, blot it dry with a lint-free tissue and insert it into the sample.

2. Follow the instructions in the meter user guide for performing a measurement.

3. Remove the RDO sensor from the sample, rinse it with distilled water, blot it dry with a lint-free tissue, insert the sensor into the next sample and repeat step 2 or refer to the **RDO Sensor Storage** section for the recommended storage procedures.

RDO Sensor Storage

Short Term Storage

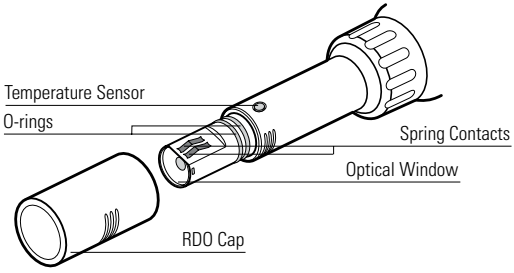
Between measurements and overnight, leave the RDO cap on the RDO sensor and keep the sensor in the calibration sleeve, making sure to wet the sponge with distilled water, or in a beaker with distilled water. Keep the RDO sensor away from direct sunlight during storage.

Long Term Storage

Leave the RDO cap on the RDO sensor and keep the sensor in the calibration sleeve, making sure to wet the sponge with distilled water, or in a beaker with distilled water. Keep the RDO sensor away from direct sunlight during storage.

RDO Sensor Maintenance

Figure 7 – RDO Sensor and RDO Cap



Cleaning the RDO Cap

1. Make sure that the RDO cap is properly installed on the RDO sensor and rinse the cap and temperature sections of the sensor with distilled water from a squirt bottle or spray bottle and blot dry with a lint-free soft cloth.

2. Inspect the RDO cap for scratches or discoloration and replace the cap if any flaws are observed. If algal growth is present on the RDO cap, gently clean it with a soft brush.

Note: *Do not use solvents or soaps to clean the RDO cap and do not rub the cap with abrasive material. Use of these materials will damage the RDO cap and void the warranty. Do not let salt or mineral deposits form on the RDO cap. To remove salt or mineral deposits from the cap, refer to step 2 in the* ***Cleaning the RDO Sensor Body*** *section.*

Cleaning the RDO Sensor Body

1. Make sure that the RDO cap is properly installed on the sensor and gently scrub the sensor body with a soft brush.

2. Calcareous fouling can normally be dissolved with household vinegar. Disconnect the RDO sensor from the meter and soak the assembled sensor, with the RDO cap installed on the sensor, in vinegar overnight. If the marine growth remains, use clean cotton swabs to gently wipe the growth off after it has been softened by soaking in vinegar.

3. After cleaning the RDO sensor, thoroughly rinse the sensor in distilled water and blot it dry with a lint-free tissue before using or storing it. After cleaning the RDO sensor, a water-saturated air calibration should be performed.

Cleaning the Optical Window

1. Remove the RDO cap and gently wipe the optical window with a clean lens cloth.

Note: *Do not wet the optical window area with water or any other solution.*

Yearly Replacement of the RDO Cap

The RDO cap must be replaced every 365 days. The meter will display an Err 881 message when the RDO cap needs to be replaced. To view the days remaining before the RDO cap must be replaced, refer to the meter user guide.

1. Turn the power to the meter off.

2. Remove the old RDO cap from the RDO sensor. Pull the cap straight off of the sensor and do not twist the cap.

3. Remove the existing two O-rings from the RDO sensor.

4. Remove any moisture from the RDO sensor body with a lint-free tissue. Do not touch the optical window or spring contacts with anything other than a lint-free tissue. Make sure that there is no moisture in the O-ring grooves.

5. Apply a thin film of silicone grease around the O-ring grooves and install the two new O-rings on the sensor. Only use the silicone grease and O-rings that are supplied with the RDO cap.

6. Lubricate the two O-rings on the RDO sensor with a thin film of silicone grease. Do not allow any silicone grease to touch the optical window or spring contacts.

7. Examine the optical window for scratches or dirt and clean it if necessary. To clean the optical window, gently wipe it with a clean lens cloth.

8. Install a new RDO cap onto the RDO sensor by aligning the arrow on the cap with the arrow on the sensor and pressing the cap onto the sensor until the cap is flush with the sensor body. Do not twist the RDO cap. Make sure that the O-rings are not pinched or rolled between the cap and the sensor.

9. Turn the power to the meter on.

10. After replacing the RDO cap, a water-saturated air calibration should be performed.

Troubleshooting

The most important principle in troubleshooting is to isolate the components of the system and check each in turn. The components of the system include the meter, RDO sensor, sample and technique.

Meter

The meter is the easiest component to eliminate as a possible cause of error. Thermo Scientific Orion meters include an instrument checkout procedure in the meter user guide. Consult the meter user guide for complete instructions and verify that the meter operates correctly and is stable in all steps.

RDO Sensor

1. Rinse the RDO sensor thoroughly with distilled water, blot it dry with a lint-free tissue and inspect the RDO cap for scratches or discoloration.

2. Remove the RDO cap from the RDO sensor and make sure that there is no water inside the cap, the optical window is clean and clear, the O-rings are intact and have a thin coating of silicone grease and the spring contacts are clean and undamaged.

3. If readings continue to be erratic and unstable, the RDO cap may need to be replaced. Refer to the **RDO Sensor Maintenance** section.

Sample

If the RDO sensor works properly in standards but not in the sample, look for possible interferences or substances in the sample that could alter the sensor response or physically damage the sensor. If possible, determine the composition of the sample and check for issues.

Technique

Check if the method of analysis is compatible with your sample.

Troubleshooting Chart

Issue	Recommended Action
Unable to calibrate the RDO sensor	Verify the calibration setup and procedure.
	Make sure that no water droplets are on the surface of the RDO cap.
	Perform RDO sensor maintenance. Refer to the **Troubleshooting** and **RDO Sensor Maintenance** sections.
Dissolved oxygen measurements are unstable	Measurements may take longer if the solution temperature is unstable.
	Perform RDO sensor maintenance. Refer to the **Troubleshooting** and **RDO Sensor Maintenance** sections.
	Interfering substance may be present.
Dissolved oxygen measurement is too low	Salt may be present in the sample. Set the salinity factor in the meter.
	Perform RDO sensor maintenance. Refer to the **Troubleshooting** and **RDO Sensor Maintenance** sections.
Wrong temperature displayed	Verify that the temperature sensor on the RDO sensor is immersed in the solution.
	Contact Technical Support.
Bad zero point calibration	The RDO sensor must be in an oxygen-free solution for at least five minutes.
	Make sure that the open area between the sensor and bottle is covered with parafilm.
Bad reading after zero point calibration	Soak the RDO sensor in distilled water for 30 minutes, use a wash bottle to thoroughly rinse the sensor with distilled water and then soak the sensor for another 30 minutes in fresh distilled water.
Err 880 error message	The RDO sensor is not fully connected to the meter. Reconnect the RDO sensor.
Err 881 error message	The RDO cap has expired. Install a new RDO cap.
Err 882 error message	Verify that the RDO cap is fully seated on the sensor body.
	Install a new RDO cap.

Interfering Substances

Alcohols greater than 5%, hydrogen peroxide (H_2O_2) greater than 3%, sodium hypochlorite (NaClO, commercial bleach) greater than 3%, gaseous sulfur dioxide (SO_2) and gaseous chlorine (Cl_2) may interfere with the dissolved oxygen measurements. If the measurements are unstable and other troubleshooting procedures do not correct the problem, there may be interfering substances present in the solution.

Carbon dioxide (CO_2), ammonia (NH_3), pH, any ionic species like sulfide (S_2^-), sulfate (SO_4^{-2}), chloride (Cl^-) and hydrogen sulfide (HS^-) do not interfere with the dissolved oxygen measurements.

Substances That Damage the RDO Sensor

Do not use the RDO sensor in solutions that contain organic solvents, such as acetone, chloroform or methylene chloride.

Assistance

After troubleshooting all components of your measurement system, contact Technical Support. Within the United States call 1.800.225.1480 and outside the United States call 978.232.6000 or fax 978.232.6031. In Europe, the Middle East and Africa, contact your local authorized dealer. For the most current contact information, visit www.thermo.com/contactwater.

For the latest application and technical resources for Thermo Scientific Orion products, visit www.thermo.com/waterapps.

Warranty

For the most current warranty information, visit www.thermo.com/water.

WEEE Compliance

This product is required to comply with the European Union's Waste Electrical & Electronic Equipment (WEEE) Directive 2002/96/EC. It is marked with the symbol on the left.

We have contracted with one or more recycling/disposal companies in each EU Member State and this product should be disposed of or recycled through them. Further information on compliance with these directives, the recyclers in your country and information on Thermo Scientific Orion products that may assist the detection of substances subject to the RoHS directive are available at www.thermo.com/WEEERoHS.

Ordering Information

Cat. No.	Description
087010MD	RDO optical dissolved oxygen sensor with 3 meter cable, RDO cap, calibration sleeve and stainless steel protective guard
087020MD	RDO optical dissolved oxygen sensor with 6 meter cable, RDO cap, calibration sleeve and stainless steel protective guard
087030MD	RDO optical dissolved oxygen sensor with 10 meter cable, RDO cap, calibration sleeve and stainless steel protective guard
087050MD	RDO optical dissolved oxygen sensor with 15 meter cable, RDO cap, calibration sleeve and stainless steel protective guard
087100MD	RDO optical dissolved oxygen sensor with 30 meter cable, RDO cap, calibration sleeve and stainless steel protective guard
087001	Replacement RDO cap
087002	Stainless steel protective guard
087003	Calibration sleeve

Specifications

Dissolved Oxygen Range	0 to 20 mg/L 0 to 200 %
Dissolved Oxygen Accuracy	± 0.1 mg/L up to 8 mg/L ± 0.2 mg/L from 8 to 20 mg/L
Dissolved Oxygen Resolution	0.01 mg/L
Dissolved Oxygen Response Time	90% of final value in 30 seconds, 95% of final value in 90 seconds
Temperature Range	5 to 45 °C
Temperature Accuracy	± 0.3 °C
Minimum Immersion Depth	40 mm
Sensor Length (Tip)	70 mm
Sensor Diameter (Tip)	20 mm
Total Sensor Length	190 mm
Total Sensor Diameter	35 mm
Cable Length	087010MD – 3 meters 087020MD – 6 meters 087030MD – 10 meters 087050MD – 15 meters 087100MD – 30 meters
RDO Cap Expected Lifespan	1 year

Specifications are subject to change without notice

Thermo Fisher Scientific

Environmental Instruments
Water Analysis Instruments

North America
166 Cummings Center
Beverly, MA 01915 USA
Toll Free: 1-800-225-1480
Tel: 1-978-232-6000
Dom. Fax: 1-978-232-6015
Int'l Fax: 978-232-6031

Europe
P.O. Box 254, 3860 AG Nijkerk
Wallerstraat 125K, 3862 BN
Nijkerk, The Netherlands
Tel: (31) 033-2463887
Fax: (31) 033-2460832

Asia Pacific
Blk 55, Ayer Rajah Crescent
#04-16/24, Singapore 139949
Tel: 65-6778-6876
Fax: 65-6773-0836

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